1   Paul R. Kiesel, State Bar No. 119854
       kiesel@kiesel.law
2   Jeffrey A. Koncius, State Bar No. 189803
       koncius@kiesel.law
3   Nicole Ramirez, State Bar No. 279017
       ramirez@kiesel.law
4   **KIESEL LAW LLP**
     8648 Wilshire Boulevard
5   Beverly Hills, CA 90211-2910
     Tel: 310-854-4444
6   Fax: 310-854-0812

7   Michael W. Sobol, State Bar No. 194857
       msobol@lchb.com
8   Melissa Gardner, State Bar No. 289096
       mgardner@lchb.com
9   Jallé H. Dafa, State Bar No. 290637
       jdafa@lchb.com
10   **LIEFF CABRASER HEIMANN
       & BERNSTEIN, LLP**
11   275 Battery Street, 29th Floor
     San Francisco, CA 94111-3339
12   Tel: 415-956-1000
     Fax: 415-956-1008

13

     Counsel for Plaintiffs and the Proposed
14   *Classes*

Jason 'Jay' Barnes (admitted *pro hac vice*)
  jaybarnes@simmonsfirm.com
Eric Johnson (admitted *pro hac vice*)
  ejohnson@simmonsfirm.com
An Truong (admitted *pro hac vice*)
  atruong@simmonsfirm.com
SIMMONS HANLY CONROY LLC
112 Madison Avenue, 7th Floor
New York, NY 10016
Tel.: 212-784-6400
Fax: 212-213-5949

Douglas Cuthbertson (to be admitted *pro hac vice*)
  dcuthbertson@lchb.com
**LIEFF CABRASER HEIMANN
  & BERNSTEIN, LLP**
250 Hudson Street, 8th Floor
New York, NY 10013
Tel: 212-355-9500
Fax: 212-355-9592

15   **UNITED STATES DISTRICT COURT**
                NORTHERN DISTRICT OF CALIFORNIA
16   **SAN JOSE DIVISION**

17   JOHN DOE I and JOHN DOE II, on behalf
     of themselves and all others similarly
18   situated,

19   Plaintiffs,

20   v.

21   GOOGLE LLC,

22   Defendant.

23

Case No. 5:23-cv-02431-BLF

**DECLARATION OF DR. ZUBAIR SHAFIQ
IN SUPPORT OF PLAINTIFFS' MOTION
FOR PRELIMINARY INJUNCTION AND
PROVISIONAL CLASS CERTIFICATION**

Date: November 2, 2023
Time: 9:00 A.M.
Judge: Hon. Beth Labson Freeman

24

25

26

27

28

DECLARATION OF DR. ZUBAIR SHAFIQ

I, ZUBAIR SHAFIQ, hereby declare under penalty of perjury:

1.   I am an associate professor of computer science at University of California, Davis, where I teach, conduct research and analyze issues involving Internet privacy, security, and performance, using network measurement and machine learning techniques.

2.   I have been retained by Plaintiffs' counsel and submit this declaration in support of Plaintiffs' Motion for Preliminary Injunction.

3.   I have personal knowledge of the facts set forth herein and, if called as a witness, could and would testify competently to them.

4.   I reserve the right to modify, supplement or otherwise amend my statements, analyses, and conclusions in this declaration should new and additional information become available to me.

I.   QUALIFICATIONS

1.   I am an associate professor of computer science at University of California, Davis, where I run a lab and conduct research that focuses on Internet privacy, security, and performance, using network measurement and machine learning techniques. In particular, my research over the last several years has specifically aimed to uncover personal data collection, sharing, and usage in the online advertising ecosystem. In addition to my lab and research work, I regularly teach undergraduate and graduate courses on computer networks and computer security, including special topics courses covering emerging trends in online advertising and tracking.

2.   I have co-authored nearly 100 peer-reviewed research papers, and have received several awards and distinctions for my research. Notably, I was the recipient of the 2018 Andreas Pfitzmann Award at the flagship Privacy Enhancing Technologies Symposium for my research on designing a system to reliably detect advertising and tracking information flows in mobile apps. I also received the Best Paper Award at the 2017 ACM Internet Measurement Conference for my research on exposing and investigating the abuse of a security vulnerability in Facebook Graph API's implementation of 3rd party apps. I also received the Best Paper Award at the 2012 IEEE

1   International Conference on Network Protocols for my research on reverse engineering proprietary

2   network protocols through network traffic analysis.

3   3.   My full qualifications are set forth in my curriculum vitae, which is attached as

4   Exhibit A.

5   4.   I have been retained by counsel for Plaintiffs as an expert in this matter and submit

6   this declaration in support of Plaintiffs' Motion for Preliminary Injunction.

7   5.   I reserve the right to amend, modify, or supplement my opinions as new or additional

8   information becomes available to me

9   **II.   ASSIGNMENT AND SUMMARY OF CONCLUSIONS**

10   6.   I have been asked to conduct entropy analysis to determine whether the information

11 obtained by Google source code – specifically Google Analytics, Google Ads, and Google Display

12 Ads – may be considered personally identifiable information (PII) about patients on health care

13 related websites and apps. Based on my analysis of the information collected, my conclusion is yes.

14 As I explain below, the information collected by Google far exceeds a critical amount of user-

15 identifying entropy. The information collected by Google allows it to identify patients uniquely and

16 persistently on health care related websites and apps.

17   7.   I have been asked to analyze whether a data company, like Google, can readily

18 identify health care related websites and apps. My conclusion is yes. Data companies, like Google,

19 should have the systems and tools in place to identify website and app content. In the case of

20 Google, I am aware that Google does indeed have specific tools that can do this work. Based on

21 my experience and expertise, as well as my analysis of various tools available to data companies,

22 it is my opinion that Google can identify health care related websites and apps using its own

23 Verticals taxonomy and content classification API, as well as off-the-shelf content classification

24 services.

25

26

27

28

III.   OVERVIEW OF ENTROPY

8.   The scientific community has widely adopted entropy as a metric to quantify privacy risk of identifiability of an individual.[1] Entropy is measured in terms of bits. If the number of entropy bits for a piece of data – either alone or combined with other information – exceed a certain threshold, then the concept of entropy concludes that the data can be used to uniquely (re)identify users.

9.   Google itself uses entropy to quantify privacy risk. For example, Google's Privacy Sandbox project uses entropy to determine "Privacy Budget."[2] Outside of Google, the privacy non-profit public interest group Electronic Frontier Foundation[3] and the Mozilla[4] browser also used entropy as a metric to assess identifiability of information.

10.   Google Chrome uses entropy to label APIs "that exposes data that folks on the internet find useful for fingerprinting". "Attributes and methods marked as [HighEntropy] are

---

[1] Note that dozens of privacy metrics and analysis techniques have been proposed in the scientific community over the past few decades. The following paper by Wagner and Eckhoff – that surveys more than 80 privacy metrics – explains that most of these metrics either directly build on entropy or are indirectly related to entropy. For this reason, and – as explained below – because Google also extensively uses entropy for privacy assessment, I use entropy for privacy analysis. However, the same conclusion can be reached if other privacy metrics are suitably used to analyze the information collected by the Google Source Code – specifically Google Analytics, Google Ads, and Google Displays Ads.

Wagner, I. and Eckhoff, D., 2018. Technical privacy metrics: a systematic survey. ACM Computing Surveys, 51(3).

[2] Privacy Budget: Limit the amount of individual user data exposed to sites to prevent covert tracking. https://developer.chrome.com/en/docs/privacy-sandbox/privacy-budget/

[3] A Primer on Information Theory and Privacy https://www.eff.org/deeplinks/2010/01/primer-information-theory-and-privacy

[4] Technical Comments on Privacy Budget https://mozilla.github.io/ppa-docs/privacy-budget.pdf

known to be practically useful for identifying particular clients on the web today." [5] See, for

example[6] (emphasis added):

```
[HighEntropy=Direct, MeasureAs=NavigatorMaxTouchPoints] readonly attribute long maxTouchPoints;
```

11.   The minimum amount of entropy required to uniquely identify a person in a population of size N is $\log_2(N)$. Given that Earth's population is approximately 8 billion, the number of required bits is $\log_2$ (8 billion) = 32.897 ≈ 33 bits. Given that the number of Internet users on Earth is ≈ 4 billion, the number of required entropy bits to uniquely identify a user or device on the Internet is $\log_2$(4 billion) = 31.897 ≈ 32 bits.[7]

12.   Google itself uses 32 bits of entropy as the identifiability threshold. As shown in Figure 1, Google uses the 32 bits as the identifiability threshold[8] in calculating its "Privacy Budget". As another example, as shown in Figure 2, the FAQ page of Google's Privacy Budget project justifies the use of the 32-bit entropy threshold for identifiability.[9]
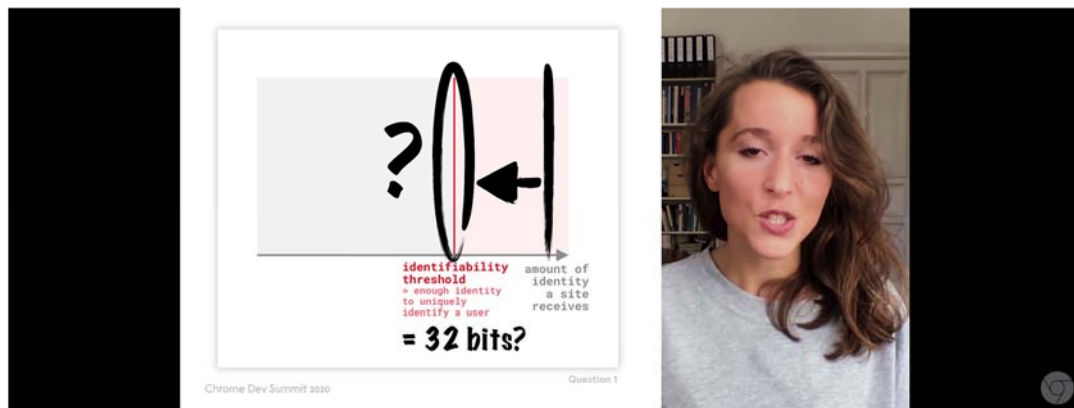

Figure 1: Google employee explains that the 32-bit identifiability threshold is enough to uniquely identify a user.

---

[5]
https://chromium.googlesource.com/chromium/src/+/main/third_party/blink/renderer/bindings/IDLExtendedAttributes.md#HighEntropy_m_a_c
[6]
https://source.chromium.org/search?q=HighEntropy%3DDirect&ss=chromium%2Fchromium%2Fsrc
[7] https://www.eff.org/deeplinks/2010/01/primer-information-theory-and-privacy
[8] Introducing the Privacy Budget https://www.youtube.com/watch?v=0STgfjSA6T8&t=423s
[9]   https://github.com/mikewest/privacy-budget/blob/4e5f78adde92bd622dafeceae78682fc0823c0eb/faq.md
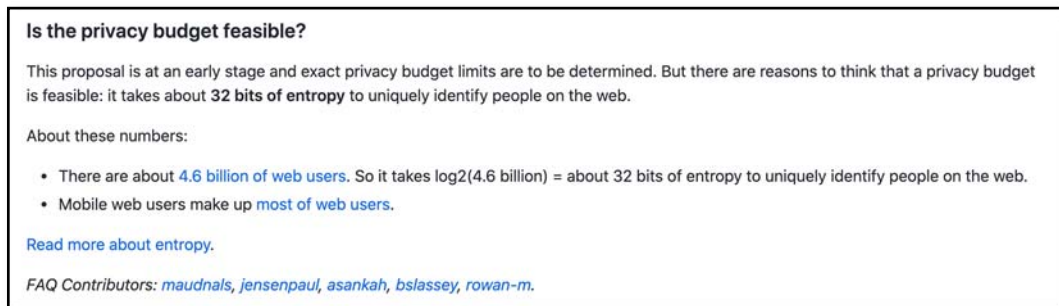
Figure 2: Google explains entropy and the 32-bit identifiability threshold.

13.   Thus, under the concept of entropy, individual pieces of data in a given transmission are evaluated and assigned a value of bits. The bits are then totaled and if they exceed 32-bits then that information combination is deemed to be identifiable within the scientific community.[10]

IV.   ANALYSIS

14.   To apply the entropy concept, I analyzed network transmissions from an individual's web browser when they are communicating with a health care provider, for example, MedStar Health. I then focus on the network transmissions that, in the course of the individual's communication with MedStar, are also being made to Google via Google Analytics, Google Ads and Google Displays Ads. Specifically, I look at the network transmissions that occur in the following example: when loading the "Abdominal Aneurysm Treatment | MedStar Health" webpage included in the Amended Complaint: https://www.medstarhealth.org/services/abdominal-aneurysm-treatment.

15.   I found that Google collected at least the following four types of identifying information from the patient's browser:[11]

---

[10] A caveat to be aware of when calculating the "joint" entropy is that we should not simply sum up entropy of different pieces of data if they are dependent with each other. If different pieces of data are dependent, then the joint entropy could be lower than the simple sum of entropy of different pieces of data. Thomas M. Cover; Joy A. Thomas. Elements of Information Theory. Wiley (2006)

[11] I focus on these four types of information because, as discussed further below, they far exceed the entropy threshold for identifiability. But, based on my experience, expertise, and review of network transmissions, there is additional information that is sent to Google, which may also contribute to the entropy threshold. For the sake of brevity, I do not analyze each and every piece of data transmitted but can do so if the Court so requires.

a. IP address

b. User agent

c. Cookies, such as:[12]

    i. _ga cookie used to distinguish patients with 2 years' expiration and exfiltrated via cid URL parameter;

    ii. _gid cookie used to distinguish patients with 24 hours' expiration and exfiltrated via _gid URL parameter;

    iii. _gcl_au cookie used for conversion tracking with 3 months' expiration and exfiltration via auiddc URL parameter;

    iv. Third-party AEC cookie on google.com with session based expiration;

    v. Third-party IDE cookie on doubleclick.net containing unique device identifier with 13 months' expiration;

    vi. Third-party DSID cookie on doubleclick.net containing Google account identifier with 2 weeks' expiration; and

    vii. Third-party NID cookie on google.com containing unique device identifier with 6 months' expiration.

d. Device attributes, such as:

    i. Screen resolution exfiltrated via sr URL parameter;

    ii. Viewport size exfiltrated via vp URL parameter;

    iii. Document encoding exfiltrated via de URL parameter;

    iv. Screen color depth exfiltrated via sd URL parameter;

    v. Language exfiltrated via ul URL parameter;

    vi. Whether Java is enabled exfiltrated via je URL parameter;

    vii. Device architecture exfiltrated via uaa URL parameter;

    viii. Device bitness exfiltrated via uab URL parameter;

---

[12] I note that while the _ga, _gid, and _gcl_au cookies belong to Google (a third party to the communication between the individual and their health care provider), these three Google cookies nonetheless appear as "first-party" cookies. This makes it much more difficult for individuals to prevent the transmission of information to third-party Google.

ix.   Whether the device is mobile exfiltrated via uamb URL parameter;

x.   Device model exfiltrated via uam URL parameter;

xi.   Device platform exfiltrated via uap URL parameter;

xii.   Device platform version number exfiltrated via uapv URL parameter;

xiii.   Whether Windows OS on Windows 64 bit is supported exfiltrated via WOW64 parameter;

xiv.   User agent full version list exfiltrated via uafvl URL parameter;

xv.   Accepted encoding via Accept-Encoding header;

xvi.   Accepted language via Accept-Language header;

xvii.   Cache control via Cache-Control header; and

xviii.   Which content types client is able to understand via Accept header.

16.   Below I conduct entropy analysis of the aforementioned four types of identifying information collected by Google.

17.   First, the IP address by itself is a sufficiently unique and persistent identifier to be classified as PII.

a.   There are two prevalent IP protocols: IPv4 and IPv6. The length of IPv4 address is 32 bits (i.e., ≈4 billion possible IPv4 addresses). Note that IPv4 addresses are sometimes reused or shared across users (e.g., using a mechanism called Network Address Translation [NAT]). The new IPv6 protocol is now used by approximately one-half of Internet users in the United States.[13] The length of IPv6 address is 128 bits (i.e., ≈340 trillion-trillion-trillion IP addresses possible IPv6 addresses). Thus, IP address, especially the newer IPv6 variant, is able to uniquely identify patients.

b.   While IP addresses may not always be static (i.e., they can change), peer-reviewed research[14] shows that the IP address by itself remains a serious threat to tracking despite the use of non-static IP addresses. Specifically, researchers showed that

---

[13] https://www.google.com/intl/en/ipv6/statistics.html

[14] Don't Count Me Out: On the Relevance of IP Address in the Tracking Ecosystem
https://dl.acm.org/doi/pdf/10.1145/3366423.3380161

1   "87% of participants retain at least one IP address for more than a month". For the

2   study participants in the United States, the average IP address retention period was

3   18.93 days. Thus, IP address is a persistent identifier.

4   18.   Second, the user agent also contains a significant amount of entropy. There are

5   approximately 10 bits of entropy in user agent. More specifically, 10.000 according to this EFF

6   study[15] and 9.779 bits according to this AmIUnique study.[16] As discussed below, user agent when

7   combined with other information collected by Google easily exceeds the 32-bit identifiability

8   threshold.

9   19.   Third, since arbitrary information can be stored in cookies, there is really no limit to

10   how many bits of entropy (identifying information) can be stored in cookies. Google typically

11   stores Universally Unique Identifier (UUID) in the aforementioned cookies.[17] Assuming each

12   character encodes up to 8 bits of information, the total entropy for the NID cookie alone would be

13   211 characters x 8 bits = 1,688 bits. Similarly, each of the other identifier cookies listed above far

14   exceeds the 32-bit identifiability threshold.

15   20.   Fourth, the various device attributes collected by Google also contain sufficient

16   entropy that can be combined[18] with IP address and user agent to exceed the 32-bit identifiability

17   threshold. For example, IP address (containing up to 32 bits for IPv4 and up to 128 bits for IPv6)

18   and user agent (containing approximately 10 bits) can be combined with various device attributes:

19   screen/viewport size and color depth (7.72 bits), screen resolution (4.89 bits), Accept-Language

20

21

22

23   [15] Peter Eckersley. How unique is your web browser? International Symposium on Privacy Enhancing Technologies Symposium, pages 1–18. Springer, 2010.

24   [16] Pierre Laperdrix, Walter Rudametkin, and Benoit Baudry. Beauty and the beast: Diverting

25   modern web browsers to build unique browser fingerprints. IEEE Symposium on Security and Privacy, pages 878–894. 2016.

26   [17] https://developers.google.com/analytics/devguides/collection/protocol/v1/parameters#cid

27   [18] While the overall entropy of a combination of fields cannot be computed by simply adding them

28   up if they are not independent as I discussed above, there is clear sufficient entropy together in these fields such that the joint entropy easily surpasses the 32-bit identifiability threshold.

(5.918 bits), Accept-Encoding (1.53 bits), Device platform (2.31 bits), Accept (2.21 bits), and whether device is mobile (0.68 bits) to exceed the 32 bit identifiability threshold.[19],[20]

21.   In summary, the various pieces of information collected by Google Analytics, Google Ads, and Google Displays Ads far exceeds the 32-bits entropy identifiability threshold. My conservative analysis shows that the information collected by Google allows it to identify individuals uniquely and persistently on health care related websites and apps.

V.   HEALTH CARE CONTENT CLASSIFICATION

22.   Google provides advertisers a well-known "Verticals" taxonomy[21] to target content of various categories. These include at least 89 specific "/Health" related verticals such as "/Health/Health Conditions/Cancer" and "/Health/Health Conditions/AIDS & HIV".

23.   It is my opinion that Google possesses the technology to use its taxonomies to classify content on health care related websites and apps. Google's initial claim to fame was its search engine that is based on "processing and analyzing the textual content and key content tags and attributes".[22]

24.   Based on my experience and expertise, it is my opinion that Google can likely easily identify health care related websites and apps using this content classification technology. In fact, Google publicly provides a "content categories" classification API[23] that it can use to identify health care related websites and apps, including those that are classified into verticals such as "/Health/Health Conditions/Cancer" and "/Health/Health Conditions/AIDS & HIV".

---

[19] https://coveryourtracks.eff.org/

[20] Pierre Laperdrix, Walter Rudametkin, and Benoit Baudry. 2016. Beauty and the beast: Diverting modern web browsers to build unique browser fingerprints. 37th IEEE Symposium on Security and Privacy.

[21] https://developers.google.com/adwords/api/docs/appendix/verticals

[22] https://developers.google.com/search/docs/fundamentals/how-search-works

[23] Cloud Natural Language API https://cloud.google.com/natural-language/docs/categories

1   25.   In addition, I am aware of several off-the-shelf content classification services (e.g.,

2   WebShrinker[24], RapidAPI[25], Klazify[26]) that Google and anyone else can use to identify health care

3   related websites and apps. These services are available for free (but rate and quota limited) or can

4   be obtained at a reasonable cost (e.g., $100 per month for 30 million content classification

5   decisions[27]).

6   *   *   *

7   I declare under penalty of perjury under the laws of the United States of America that the

8   foregoing is true and correct.

9   Executed this 12th day of June 2023 at Davis, California.

10

11   /s/ _____

12   Dr. Zubair Shafiq

13

14

15

16

17

18

19

20

21

22

23

24

25

---

26   [24] Website Categories https://docs.webshrinker.com/v3/iab-website-categories.html#tier-1-and-tier-2-categories

27   [25] https://rapidapi.com/ibmbpmtips/api/iab-taxonomy-text-classification/details

28   [26] https://www.klazify.com/

[27] https://rapidapi.com/ibmbpmtips/api/iab-taxonomy-text-classification/pricing

EXHIBIT "A"

Zubair Shafiq

3043 Kemper Hall
Davis, CA, 95616 USA
✉ *zubair@ucdavis.edu*
🌐 *www.cs.ucdavis.edu/~zubair*

Research Interests

Web Privacy, Internet Measurement, Internet Security, Computer Networks

Professional Experience

2020–	**Associate Professor** Department of Computer Science, University of California-Davis
2014–2020	**Assistant Professor** Department of Computer Science, University of Iowa
2009–2014	**Research Assistant** Department of Computer Science and Engineering, Michigan State University
2013	**Research Intern** IBM T. J. Watson Research Center
2012	**Research Intern** Telefonica Research
2011	**Research Intern** AT&T Labs – Research
2007-2009	**Research Engineer** Next Generation Intelligent Networks Research Center, Pakistan

Education

2009–2014	**Ph.D. Computer Science** Department of Computer Science and Engineering, Michigan State University
2004–2008	**B.E. Electrical Engineering** National University of Sciences & Technology (NUST), Pakistan

Honors and Awards

2023	**Chancellor's Fellow**, University of California Davis
2020	**Research Highlights**, Communications of the ACM
2020	**Dean's Scholar Award**, University of Iowa
2018	**NSF Faculty Early Career Development (CAREER) Award**
2018	**Andreas Pfitzmann Best Student Paper Award**, Privacy Enhancing Technologies Symposium
2017	**Best Paper Award**, ACM Internet Measurement Conference
2015	**NSF CISE Research Initiation Initiative (CRII) Award**
2013	**Fitch-Beach Outstanding Graduate Research Award**, Michigan State University
2012	**Best Paper Award**, IEEE International Conference on Network Protocols
2007, 2008	**Dean's Plaque of Excellence**, National University of Sciences & Technology, Pakistan

Publications

arXiv **The Inventory is Dark and Full of Misinformation: Understanding the Abuse of Ad Inventory Pooling in the Ad-Tech Supply Chain**
Yash Vekaria, Rishab Nithyanand, Zubair Shafiq
arXiv:2210.06654, 2022

arXiv **Your Echos are Heard: Tracking, Profiling, and Ad Targeting in the Amazon Smart Speaker Ecosystem**
Umar Iqbal, Pouneh Nikkhah Bahrami, Rahmadi Trimananda, Hao Cui, Alexander Gamero-Garrido, Daniel Dubois, David Choffnes, Athina Markopoulou, Franziska Roesner, Zubair Shafiq
arXiv:2204.10920, 2022

JOLT **A Scientific Approach to Tech Accountability**
Woodrow Hartzog, Scott Jordan, David Choffnes, Athina Markopoulou, Zubair Shafiq
Beyond the FTC: The Future of Privacy Enforcement, Harvard Journal of Law & Technology, in press

PNAS **YouTube, The Great Radicalizer? Auditing and Mitigating Ideological Biases in YouTube Recommendations**
Muhammad Haroon, Magdalena Wojcieszak, Anshuman Chhabra, Xin Liu, Prasant Mohapatra, Zubair Shafiq
Proceedings of the National Academy of Sciences (PNAS), in press

PETS **A Utility-Preserving Obfuscation Approach for YouTube Recommendations**
Jiang Zhang, Hadi Askari, Konstantinos Psounis, Zubair Shafiq
Privacy Enhancing Technologies Symposium, 2023

PETS **Blocking JavaScript without Breaking the Web**
Abdul Haddi Amjad, Zubair Shafiq, Muhammad Ali Gulzar
Privacy Enhancing Technologies Symposium, 2023

CCS **CookieGraph: Measuring and Countering First-Party Tracking Cookies**
Shaoor Munir, Sandra Siby, Umar Iqbal, Steven Englehardt, Zubair Shafiq, Carmela Troncoso
ACM Conference on Computer and Communications Security, 2023

S&P **Accuracy-Privacy Trade-off in Deep Ensemble: A Membership Inference Perspective**
Shahbaz Rezaei, Zubair Shafiq, Xin Liu
IEEE Symposium on Security & Privacy, 2023

USENIX **AutoFR: Automated Filter Rule Generation for Adblocking**
Security Hieu Le, Salma Elmalaki, Athina Markopoulou, Zubair Shafiq
USENIX Security Symposium, 2023

NDSS **Harpo: Learning to Subvert Online Behavioral Advertising**
Jiang Zhang, Konstantinos Psounis, Muhammad Haroon, Zubair Shafiq
Network and Distributed System Security Symposium, 2022

USENIX **WebGraph: Capturing Advertising and Tracking Information Flows for Robust Blocking**
Security Sandra Siby, Umar Iqbal, Steven Englehardt, Zubair Shafiq, Carmela Troncoso
USENIX Security Symposium, 2022

USENIX **Khaleesi: Breaker of Advertising and Tracking Request Chains**
Security Umar Iqbal, Charlie Wolfe, Charles Nguyen, Steven Englehardt, Zubair Shafiq
USENIX Security Symposium, 2022

PETS **FP-Radar: Longitudinal Measurement and Early Detection of Browser Fingerprinting**
Pouneh Nikkhah Bahrami, Umar Iqbal, Zubair Shafiq
Privacy Enhancing Technologies Symposium, 2022

ACL **Adversarial Authorship Attribution for Deobfuscation**
Wanyue Zhai, Jonathan Rusert, Zubair Shafiq, Padmini Srinivasan
Association for Computational Linguistics, 2022

ACL **On the Robustness of Offensive Language Classifiers**
Jonathan Rusert, Zubair Shafiq, Padmini Srinivasan
Association for Computational Linguistics, 2022

EuroS&P **DNN Model Architecture Fingerprinting Attack on CPU-GPU Edge Devices**
Kartik Patwari, Syed Mahbub Hafiz, Han Wang, Houman Homayoun, Zubair Shafiq, Chen-Nee Chuah
IEEE European Symposium on Security and Privacy, 2022

DATE **Stealthy Inference Attack on DNN via Cache-based Side-channel Attacks**
Han Wang, Syed Mahbub Hafiz, Kartik Patwari, Chen-Nee Chuah, Zubair Shafiq, Houman Homayoun
IEEE/ACM Design Automation and Test in Europe, 2022

IMC **TrackerSift: Untangling Mixed Tracking and Functional Web Resources**
Abdul Haddi Amjad, Danial Saleem, Fareed Zaffar, Muhammad Ali Gulzar, Zubair Shafiq
ACM Internet Measurement Conference, 2021

S&P **Fingerprinting the Fingerprinters: Learning to Detect Browser Fingerprinting Behaviors**
Umar Iqbal, Steven Englehardt, Zubair Shafiq
IEEE Symposium on Security & Privacy, 2021

NDSS **CV-Inspector: Towards Automating Detection of Adblock Circumvention**
Hieu Le, Athina Markopoulou, Zubair Shafiq
Network and Distributed System Security Symposium, 2021

EACL **Through the Looking Glass: Learning to Attribute Synthetic Text Generated by Language Models**
Shaoor Munirl, Brishna Batool, Zubair Shafiq, Padmini Srinivasan, Fareed Zaffar
European Chapter of the Association for Computational Linguistics, 2021

ACL **A Girl Has A Name: Detecting Authorship Obfuscation**
Asad Mahmood, Zubair Shafiq, Padmini Srinivasan
Annual Conference of the Association for Computational Linguistics, 2020

S&P **AdGraph: A Graph-Based Approach to Ad and Tracker Blocking**
Umar Iqbal, Peter Snyder, Shitong Zhu, Benjamin Livshits, Zhiyun Qian, Zubair Shafiq
IEEE Symposium on Security & Privacy, San Francisco, 2020

PETS **CanaryTrap: Detecting Data Misuse by Third-Party Apps on Online Social Networks**
Shehroze Farooqi, Maaz Musa, Zubair Shafiq, Fareed Zaffar
Privacy Enhancing Technologies Symposium, Montreal, 2020

PETS **Inferring Tracker-Advertiser Relationships in the Online Advertising Ecosystem**
John Cook, Rishab Nithyanand, Zubair Shafiq
Privacy Enhancing Technologies Symposium, Montreal, 2020

PETS **The TV is Smart and Full of Trackers: Measuring Smart TV Advertising and Tracking**
Janus Varmarken, Hieu Le, Anastasia Shuba, Zubair Shafiq, Athina Markopoulou
Privacy Enhancing Technologies Symposium, Montreal, 2020

IoTDI **Characterizing Smart Home IoT Traffic in the Wild**
M. Hammad Mazhar, Zubair Shafiq
ACM/IEEE Conference on Internet of Things Design and Implementation, Sydney, 2020

PAM **FlowTrace: A Framework for Active Bandwidth Measurements using In-band Packet Trains**
Adnan Ahmed, Ricky Mok, Zubair Shafiq
Passive and Active Measurement Conference, Eugene, 2020

PETS **A Girl Has No Name: Automated Authorship Obfuscation using X-Mutant**
Asad Mahmood, Faizan Ahmad, Zubair Shafiq, Padmini Srinivasan, Fareed Zaffar
Privacy Enhancing Technologies Symposium, Stockholm, 2019

PETS **No Place to Hide: Inadvertent Location Privacy Leaks on Twitter**
Jonathan Rusert, Osama Khalid, Dat Hong, Zubair Shafiq, Padmini Srinivasan
Privacy Enhancing Technologies Symposium, Stockholm, 2019

WWW **Measurement and Early Detection of Third-Party Application Abuse on Twitter**
Shehroze Farooqi, Zubair Shafiq
The Web Conference (WWW), San Francisco, 2019

WWW **ShadowBlock: A Lightweight and Stealthy Adblocking Browser**
Shitong Zhu, Umar Iqbal, Zhongjie Wang, Zhiyun Qian, Zubair Shafiq, Weiteng Chen
The Web Conference (WWW), San Francisco, 2019

WWW **Measuring Political Personalization of Google News Search**
Huyen Le, Raven Maragh, Brian Ekdale, Timothy Havens, Andrew High, Zubair Shafiq
The Web Conference (WWW), San Francisco, 2019

ASONAM **A Postmortem of Suspended Twitter Accounts in the 2016 U.S. Presidential Election**
Huyen Le, Bob Boynton, Zubair Shafiq, Padmini Srinivasan
IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM), Vancouver, 2019

TDSC **Large Scale Characterization of Software Vulnerability Life Cycles**
Muhammad Shahzad, Zubair Shafiq, Alex X. Liu
IEEE Transactions on Dependable and Secure Computing, 2019

PETS **NoMoAds: Effective and Efficient Cross-App Mobile Ad-Blocking**
Anastasia Shuba, Athina Markopoulou, Zubair Shafiq
Privacy Enhancing Technologies Symposium, Barcelona, 2018
Andreas Pfitzmann Best Student Paper Award

NDSS **Measuring and Disrupting Anti-Adblockers Using Differential Execution Analysis**
Shitong Zhu, Xunchao Hu, Zhiyun Qian, Zubair Shafiq, Heng Yin
Network and Distributed System Security Symposium, San Diego, 2018

INFOCOM **Real-time Video Quality of Experience Monitoring for HTTPS and QUIC**
M. Hammad Mazhar, Zubair Shafiq
IEEE International Conference on Computer Communications, Honolulu, 2018

TON **Optimizing Internet Transit Routing for Content Delivery Networks**
Faraz Ahmed, Zubair Shafiq, Amir Khakpour, Alex Liu
IEEE/ACM Transactions on Networking, 2018

TBD **Optimizing Taxi Driver Profit Efficiency: A Spatial Network-based Markov Decision Process Approach**
Xun Zhou, Huigui Rong, Chang Yang, Qun Zhang, Amin Vahedian Khezerlou, Hui Zheng, Zubair Shafiq, Alex Liu
IEEE Transactions on Big Data, 2018

TOPS **Measuring, Characterizing, and Detecting Facebook Like Farms**
Muhammad Ikram, Lucky Onwuzurike, Shehroze Farooqi, Emiliano De Cristofaro, Arik Friedman, Guillaume Jourjon, Dali Kaafar, Zubair Shafiq
ACM Transactions on Privacy and Security, 2017

TIST **A Traffic Flow Approach to Early Detection of Gathering Events: Comprehensive Results**
Amin Khezerlou, Xun Zhou, Lufan Li, Zubair Shafiq, Alex X. Liu, Fan Zhang
ACM Transactions on Intelligent Systems and Technology, 2017

IMC **Measuring and Mitigating OAuth Access Token Abuse by Collusion Networks**
Shehroze Farooqi, Fareed Zaffar, Nektarios Leontiadis, Zubair Shafiq
ACM Internet Measurement Conference, London, 2017
Best Paper Award
CACM Research Highlights 2020

IMC **The Ad Wars: Retrospective Measurement and Analysis of Anti-Adblock Filter Lists**
Umar Iqbal, Zubair Shafiq, Zhiyun Qian
ACM Internet Measurement Conference, London, 2017

SIGMETRICS **Characterizing and Modeling Patching Practices of Industrial Control Systems**
Brandon Wang, Xiaoye Li, Leandro P. de Aguiar, Daniel S. Menasche, Zubair Shafiq
ACM International Conference on Measurement and Modeling of Computer Systems, Urbana-Champaign, 2017

PETS **Detecting Anti Ad-blockers in the Wild**
Muhammad Haris Mughees, Zhiyun Qian, Zubair Shafiq
Privacy Enhancing Technologies Symposium, Minneapolis, 2017

ICDM **Accurate Detection of Automatically Spun Content via Stylometric Analysis**
Usman Shahid, Shehroze Farooqi, Raza Ahmad, Zubair Shafiq, Padmini Srinivasan, Fareed Zaffar
IEEE International Conference on Data Mining, New Orleans, 2017

CHI **Revisiting The American Voter on Twitter**
Huyen Le, G.R. Boynton, Yelena Mejova, Zubair Shafiq, Padmini Srinivasan
ACM Conference on Human Factors in Computing Systems, Denver, 2017

ICDCS **Distributed Load Balancing in Key-Value Networked Caches**
Sikder Huq, Zubair Shafiq, Sukumar Ghosh, Amir Khakpour, Harkeerat Bedi
IEEE International Conference on Distributed Computing Systems, Atlanta, 2017

ICNP **Peering vs. Transit: Performance Comparison of Peering and Transit Interconnections**
Adnan Ahmed, Zubair Shafiq, Harkeerat Bedi, Amir Khakpour
IEEE International Conference on Network Protocols, Toronto, 2017

ICNP **Suffering from Buffering? Detecting QoE Impairments in Live Video Streams**
Adnan Ahmed, Zubair Shafiq, Harkeerat Bedi, Amir Khakpour
IEEE International Conference on Network Protocols, Toronto, 2017

ICNP **Multipath TCP Traffic Diversion Attacks and Countermeasures**
Ali Munir, Zhiyun Qian, Zubair Shafiq, Alex Liu, Franck Le
IEEE International Conference on Network Protocols, Toronto, 2017

ICWSM **Scalable News Slant Measurement Using Twitter**
Huyen Le, Zubair Shafiq, Padmini Srinivasan
AAAI International Conference on Web and Social Media, Denver, 2017

HT **Bumps and Bruises: Mining Presidential Campaign Announcements on Twitter**
Huyen Le, G.R. Boynton, Yelena Mejova, Zubair Shafiq, Padmini Srinivasan
ACM Conference on Hypertext and Social Media, Prague, 2017

Networking **Cascade Size Prediction in Online Social Networks**
Zubair Shafiq, Alex Liu
IFIP Networking, Prague, 2017
Best Paper Award Candidate (3 nominations out of 43 accepted papers)

Networking **A Graph Theoretic Approach to Fast and Accurate Malware Detection**
Zubair Shafiq, Alex Liu
IFIP Networking, Prague, 2017

eCrime **Characterizing Key Stakeholders in an Online Black-Hat Marketplace**
Shehroze Farooqi, Muhammad Ikram, Emiliano De Cristofaro, Arik Friedman, Guillaume Jourjon,
Dali Kaafar, Zubair Shafiq, Fareed Zaffar
IEEE/APWG Symposium on Electronic Crime Research, Prague, 2017

ICNP **Optimizing Internet Transit Routing for Content Delivery Networks**
Faraz Ahmed, Zubair Shafiq, Amir Khakpour, Alex Liu
IEEE International Conference on Network Protocols, Singapore, 2016

DSN **Malware Slums: Measurement and Analysis of Malware on Traffic Exchanges**
Salman Yousaf, Umar Iqbal, Shehroze Farooqi, Raza Ahmad, Zubair Shafiq, Fareed Zaffar
IEEE/IFIP International Conference on Dependable Systems and Networks, France, 2016

SIGMETRICS **QoE Analysis of a Large-Scale Live Video Streaming Event**
Adnan Ahmed, Zubair Shafiq, Amir R. Khakpour
ACM International Conference on Measurement and Modeling of Computer Systems, France, 2016

ICDCS **The Internet is For Porn: Measurement and Analysis of Online Adult Traffic**
Faraz Ahmed, Zubair Shafiq, Alex X. Liu
IEEE International Conference on Distributed Computing Systems, Japan, 2016

INFOCOM **Characterizing Caching Workload of a Large Commercial Content Delivery Network**
Zubair Shafiq, Amir R. Khakpour, Alex X. Liu
IEEE International Conference on Computer Communications, San Francisco, 2016

SIGSPATIAL **A Traffic Flow Approach to Early Detection of Gathering Events**
Xun Zhou, Amin Vahedian Khezerlou, Alex Liu, Zubair Shafiq, Fan Zhang
ACM International Conference on Advances in Geographic Information Systems, San Francisco, 2016

CIKM **The Rich and the Poor: A Markov Decision Process Approach to Optimizing Taxi Driver Revenue Efficiency**
Huigui Rong, Xun Zhou, Chang Yang, Zubair Shafiq, Alex Liu
ACM International Conference on Information and Knowledge Management, Indianapolis, 2016

TON **Characterizing and Optimizing Cellular Network Performance during Crowded Events**
Zubair Shafiq, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Shobha Venkataraman, Jia Wang
IEEE/ACM Transactions on Networking, 2016

SMP **What Campaigns Become as Social Media Become the Infrastructure of Political Communication**
G.R. Boynton, Huyen Le, Yelena Mejova, Zubair Shafiq, Padmini Srinivasan
Social Media and Politics, 2016

TMC **Geospatial and Temporal Dynamics of Application Usage in Cellular Data Networks**
Zubair Shafiq, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Jia Wang
IEEE Transactions on Mobile Computing, 2015

NSF/FCC **Tracking Mobile Video QoE in the Encrypted Internet**
QoE Zubair Shafiq
NSF/FCC Workshop on Tracking Quality of Experience in the Internet, Princeton, 2015

NSF/FCC **Bidirectional Crosslayer QoE Optimization**
QoE Srikanth Sundaresan, Zubair Shafiq
NSF/FCC Workshop on Tracking Quality of Experience in the Internet, Princeton, 2015

IMC **Paying for Likes? Understanding Facebook Like Fraud Using Honeypots**
Emiliano De Cristofaro, Arik Friedmam, Guillaume Jourjon, Dali Kaafar, Zubair Shafiq
ACM Internet Measurement Conference, 2014

SIGMETRICS **Understanding the Impact of Network Dynamics on Mobile Video User Engagement**
Zubair Shafiq, Jeffrey Erman, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Jia Wang
ACM International Conference on Measurement and Modeling of Computer Systems, 2014

SIGMETRICS **Revisiting Caching in Content Delivery Networks**
Zubair Shafiq, Alex X. Liu, Amir Khakpour
ACM International Conference on Measurement and Modeling of Computer Systems, 2014

SIGMETRICS **A First Look at Cellular Network Performance during Crowded Events**
Zubair Shafiq, Alex X. Liu, Amir Khakpour
ACM International Conference on Measurement and Modeling of Computer Systems, 2013

ICNP **Who are You Talking to? Breaching Privacy in Encrypted IM Networks**
Muhammad U. Ilyas, Zubair Shafiq, Alex X. Liu, Hayder Radha
IEEE International Conference on Network Protocols, 2013

CSCW **Is News Sharing on Twitter Ideologically Biased?**
Jonathan Morgan, Cliff Lampe, Zubair Shafiq
ACM Conference on Computer Supported Cooperative Work and Social Computing, 2013

ACM HotNets **Cross-Path Inference Attacks on Multipath TCP**
Zubair Shafiq, Franck Le, Mudhakar Srivatsa, Alex X. Liu
ACM Workshop on Hot Topics in Networks, 2013

TON **Large Scale Measurement and Characterization of Cellular Machine-to-Machine Traffic**
Zubair Shafiq, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Jia Wang
IEEE/ACM Transactions on Networking, 2013

JSAC **Identifying Leaders and Followers in Online Social Networks**
Zubair Shafiq, Muhammad U. Ilyas, Alex X. Liu, Hayder Radha
IEEE Journal on Selected Areas in Communications, 2013

JSAC **A Distributed Algorithm for Identifying Information Hubs in Social Networks**
Muhammad U. Ilyas, Zubair Shafiq, Alex X. Liu, Hayder Radha
IEEE Journal on Selected Areas in Communications, 2013

JNSM **TCAMChecker: A Software Approach to the Error Detection and Correction of TCAM-based Networking Systems**
Zubair Shafiq, Chad Meiners, Alex Liu, Ke Shen, Zheng Qin
Springer Journal of Network and Systems Management, 2012

ICNP **A Semantics Aware Approach to Automated Reverse Engineering Unknown Protocols**
Yipeng Wang, Xiaochun Yun, Zubair Shafiq, Alex X. Liu, Zhibin Zhang, Liyan Wang, Danfeng (Daphne) Yao, Yongzheng Zhang, Li Guo
IEEE International Conference on Network Protocols, 2012
Best Paper Award

SIGMETRICS **A First Look at Cellular Machine-to-Machine Traffic – Large Scale Measurement and Characterization**
Zubair Shafiq, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Jia Wang
ACM International Conference on Measurement and Modeling of Computer Systems, London, 2012

ICSE **A Large Scale Exploratory Analysis of Software Vulnerability Life Cycles**
Muhammad Shahzad, Zubair Shafiq, Alex X. Liu
International Conference on Software Engineering, Switzerland, 2012

INFOCOM **Characterizing Geospatial Dynamics of Application Usage in a 3G Cellular Data Network**
Zubair Shafiq, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Jia Wang
IEEE Conference on Computer Communications, Orlando, 2012

SIGMETRICS **Characterizing and Modeling Internet Traffic Dynamics of Cellular Devices**
Zubair Shafiq, Lusheng Ji, Alex X. Liu, Jia Wang
ACM International Conference on Measurement and Modeling of Computer Systems, San Jose, 2011

Networking **A Random Walk Approach to Modeling the Dynamics of the Blogosphere**
Zubair Shafiq, Alex X. Liu
IFIP Networking, Spain, 2011

INFOCOM **A Distributed and Privacy-Preserving Algorithm for Identifying Information Hubs in Social Networks**
Muhammad U. Ilyas, Zubair Shafiq, Alex X. Liu, Hayder Radha
IEEE Conference on Computer Communications, Spain, 2011

RAID **PE-Miner: Mining Structural Information to Detect Malicious Executables in Realtime**
Zubair Shafiq, Syeda Momina Tabish, Fauzan Mirza, Muddassar Farooq
International Symposium On Recent Advances In Intrusion Detection, France, 2009

GECCO **Evolvable Malware**
Sadia Noreen, Shafaq Murtaza, Zubair Shafiq, Muddassar Farooq
ACM Genetic and Evolutionary Computation Conference, Canada, 2009

CCS AISec **Using Spatio-Temporal Information in API Calls with Machine Learning Algorithms for Malware Detection and Analysis**
Faraz Ahmed, Haider Hameed, Zubair Shafiq, Muddassar Farooq
Workshop on Security and Artificial Intelligence, ACM Conference on Computer & Communications Security, Chicago, 2009

KDD CSI **Malware Detection using Statistical Analysis of Byte-Level File Content**
Syeda Momina Tabish, Zubair Shafiq, Muddassar Farooq
Workshop on CyberSecurity and Intelligence Informatics (CSI), ACM Conference on Knowledge Discovery and Data Mining, France, 2009

VB **PE-Probe: leveraging packer detection and structural information to detect malicious portable executables**
Zubair Shafiq, Syeda Momina Tabish, Muddassar Farooq
Virus Bulletin, Switzerland, 2009

Elsevier **Fuzzy Case Based Reasoning for Facial Expression Recognition**
Aasia Khanum, Muid Mufti, M. Y. Javed, Zubair Shafiq
Elsevier Fuzzy Sets and Systems, 2009

EvoComNet **A Comparative Study of Fuzzy Inference Systems, Neural Networks and Adaptive Neuro Fuzzy Inference Systems for Portscan Detection**
Zubair Shafiq, Muddassar Farooq, Syed Ali Khayam
Applications of Evolutionary Computing, EvoComNet, Italy, 2008

DIMVA **Embedded Malware Detection using Markov n-grams**
Zubair Shafiq, Syed Ali Khayam, Muddassar Farooq
International Conference on Detection of Intrusions, Malware and Vulnerability Assessment, France, 2008

GECCO **Improving Accuracy of Immune Inspired Malware Detectors using Intelligent Features**
Zubair Shafiq, Syed Ali Khayam, Muddassar Farooq
ACM Genetic and Evolutionary Computation Conference, Atlanta, 2008

Funding

External Competitive Research Grants

UC **Auditing Compliance of Data Privacy Laws in California**
UC Partnerships in Computational Transformation
PI, Duration: 2022-2023, Total: $160,000, Share: $80,000
Personnel: Zubair Shafiq (PI: UC Davis); Athina Markopoulou (PI: UC Irvine); Gene Tsudik (Co-PI: UC Irvine)

NSF-SaTC **Defending against Emerging Stateless Web Tracking**
National Science Foundation
PI, Duration: 2022-2026, Total: $1,200,000, Share: $400,000
Personnel: Zubair Shafiq (PI: UC Davis); Alexandros Kapravelos (PI: NC State); Anupam Das (Co-PI: NC State)

CITRIS and the Banatao Institute **Auditing the compliance of California consumer privacy regulations at scale**
Center for Information Technology Research in the Interest of Society (CITRIS)
Co-PI, Duration: 2021-2022, Total: $60,000, Share: $20,000
Personnel: Serge Egelman (Co-PI: UC Berkeley); Zubair Shafiq (Co-PI: UC Davis)

NSF-SaTC-Frontier **Protecting Personal Data Flow on the Internet**
National Science Foundation
PI, Duration: 2020-2025, Total: $10,000,000, Share: $1,100,000
Personnel: Zubair Shafiq (PI: UC Davis); Athina Markopoulou (PI: UC Irvine); Konstantinos Psounis (PI: USC); David Choffnes (PI: Northeastern)

NSF-CAREER **Quality of Experience and Network Management in the Encrypted Internet**
National Science Foundation
PI, Duration: 2018-2023, Total: $500,000, Share: $500,000
Personnel: Zubair Shafiq (PI: UC Davis)

NSF-SaTC **A Multi-Layer Learning Approach to Mobile Traffic Filtering**
National Science Foundation
PI, Duration: 2018-2021, Total: $500,000, Share: $250,000
Personnel: Zubair Shafiq (PI: UC Davis); Athina Markopoulou (PI: UC Irvine)

NSF-SaTC **The Web Ad Technology Arms Race: Measurement, Analysis, and Countermeasures**
National Science Foundation
PI, Duration: 2017-2020, Total: $500,000 + $16,000 (REU Supplement 2019) + $16,000 (REU Supplement 2021), Share: $282,000
Personnel: Zubair Shafiq (PI: UC Davis); Zhiyun Qian (PI: UC Riverside)

NSF-NeTS **Towards Scalable and Energy Efficient Cellular IoT Communication**
National Science Foundation
PI, Duration: 2016-2019, Total: $500,000, Share: $166,000
Personnel: Zubair Shafiq (PI: Iowa); K.K. Ramakrishnan (PI: UC Riverside); Koushik Kar (PI: RPI)

NSF-SaTC **Multipath TCP Side Channel Vulnerabilities and Defenses**
National Science Foundation
PI, Duration: 2015-2018, Total: $500,000, Share: $167,000
Personnel: Zubair Shafiq (PI: Iowa); Zhiyun Qian (PI: UC Riverside); Alex Liu (PI: Michigan State University)

NSF-NeTS **Towards Measurement and Optimization of Internet Video Quality of Experience**
National Science Foundation
PI, Duration: 2015-2018, Total: $175,000 + $16,000 (REU Supplement 2016), Share: $191,000
Personnel: Zubair Shafiq (PI: Iowa)

DTL **Detection and Circumvention of Ad-Block Detectors**
Data Transparency Lab
PI, Duration: 2016-2017, Total: $56,000, Share: $28,000
Personnel: Zubair Shafiq (PI: Iowa); Zhiyun Qian (PI: UC Riverside)

Internal Competitive Research Grants

Academic Senate **Socio-Computational Interventions to Mitigate Misinformation in Recommendations**
Noyce Foundation
PI, Duration: 2022-2023, Total: $25,000
Personnel: Magdalena Wojcieszak (PI), Zubair Shafiq (Co-PI)

Noyce **Measuring and Mitigating Biases in Social Recommendation Algorithms**
Noyce Foundation
PI, Duration: 2022-2023, Total: $236,000
Personnel: Zubair Shafiq (PI), Magdalena Wojcieszak (Co-PI)

Noyce **Cross-Layer Approach to Enhance Security/Privacy of AI-enabled IoT Eco-Systems**
Noyce Foundation
Co-PI, Duration: 2022-2023, Total: $225,000
Personnel: Chen-Nee Chuah (PI), Zubair Shafiq (Co-PI), Houman Homayoun (Co-PI)

Noyce **Measuring and Mitigating Biases in Social Recommendation Algorithms**
Noyce Foundation
PI, Duration: 2021-2022, Total: $235,690
Personnel: Zubair Shafiq (PI), Xin Liu (Co-PI), Magdalena Wojcieszak (Co-PI)

Noyce **Cross-Layer Approach to Enhance Security/Privacy of AI-enabled IoT Eco-Systems**
Noyce Foundation
Co-PI, Duration: 2021-2022, Total: $225,000
Personnel: Chen-Nee Chuah (PI), Zubair Shafiq (Co-PI), Houman Homayoun (Co-PI)

UIRF **Social Media Powered Real-Time Digital News Recommendation**
University of Iowa Research Foundation
PI, Duration: 2015-2016, Total: $75,000
Personnel: Zubair Shafiq (PI)

Obermann **Heterogeneous Network Data Analytics to Improve Urban Sustainability**
Obermann Center Interdisciplinary Research Grant
PI, Duration: 2015-2016, Total: $12,000
Personnel: Xun Zhou (PI); Zubair Shafiq (Co-PI)

Industry Grants and Unrestricted Gifts

Siemens PI, Duration: 2021, Total: $60,000, Share: $60,000
Personnel: Zubair Shafiq (PI: UC Davis)

Siemens PI, Duration: 2019, Total: $30,000, Share: $30,000
Personnel: Zubair Shafiq (PI: Iowa)

Siemens PI, Duration: 2018, Total: $60,000, Share: $60,000
Personnel: Zubair Shafiq (PI: Iowa)

Verizon PI, Duration: 2018, Total: $20,000, Share: $20,000
Personnel: Zubair Shafiq (PI: Iowa)

Minim PI, Duration: 2018, Total: $66,164, Share: $66,164
Personnel: Zubair Shafiq (PI: Iowa)

Siemens PI, Duration: 2017, Total: $30,000, Share: $30,000
Personnel: Zubair Shafiq (PI: Iowa)

Nokia PI, Duration: 2017, Total: $53,200, Share: $53,200
Personnel: Zubair Shafiq (PI: Iowa)

Futurewei PI, Duration: 2017, Total: $100,384, Share: $100,384
Personnel: Zubair Shafiq (PI: Iowa)

Facebook PI, Duration: 2016, Total: $8,400, Share: $8,400
Personnel: Zubair Shafiq (PI: Iowa)

Teaching

FYS **Big Data, Big Brother**
Winter 2023, University of California at Davis

ECS 289M **Network Security & Privacy**
Winter 2023, University of California at Davis

ECS 152A **Computer Networks**
Fall 2022, University of California at Davis

ECS 152A **Computer Networks**
Spring 2022, University of California at Davis

ECS 153 **Computer Security**
Winter 2022, University of California at Davis

ECS 289M	**Data-Driven Security**
	Spring 2021, University of California at Davis
ECS 152B	**Computer Networks**
	Winter 2021, University of California at Davis
CS 2620	**Networking & Security for Informatics**
	Spring 2020, The University of Iowa
CS 4980	**Online Advertising & Tracking**
	Fall 2019, The University of Iowa
CS 2620	**Networking & Security for Informatics**
	Spring 2019, The University of Iowa
CS 4980	**Internet Measurement**
	Fall 2018, The University of Iowa
CS 2620	**Networking & Security for Informatics**
	Spring 2018, The University of Iowa
CS 2620	**Networking & Security for Informatics**
	Spring 2017, The University of Iowa
CS 4980	**Network Security and Privacy**
	Fall 2016, The University of Iowa
CS 2620	**Networking & Security for Informatics**
	Spring 2016, The University of Iowa
CS 4980	**Advanced Computer Networks**
	Fall 2015, The University of Iowa
CS 2620	**Networking & Security for Informatics**
	Spring 2015, The University of Iowa
CS 4980	**Internet Measurement**
	Fall 2014, The University of Iowa

Students

Doctorate

2022-current	Rajvardhan Oak
2021-current	Muhammad Haroon
2021-current	Pouneh Nikkhah Bahrami
2021-current	Shaoor Munir
2021-current	Yash Vekaria
2021-current	Rong-Ching (Anna) Chang
2021-current	Hadi Askari
2016-2021	Dr. Umar Iqbal; First Position: CIFellow/Postdoc, University of Washington
2015-2021	Dr. Shehroze Farooqi; First Position: Researcher, Palo Alto Networks
2015-2019	Dr. Huyen Le; First Position: Postdoc, National Center for Toxicological Research

Select Recent Masters Mentees

2021	Mohammad Ismail Daud
2021	Sunshine Chong

2021	Rachit Dhamija
2020	Pouneh Nikkhah Bahrami

Select Recent Undergraduate Mentees

2022-	Jake Smith
2022-	Christina Phan
2022-	Kev Rockwell
2020-2022	Kajal Patel (NSF REU)
2020-2022	Wanyue Zhai (graduate student at Stanford)
2020-2022	Ray Ngan (NSF REU) (industry: Palo Alto Networks)
2020-2021	Surya Konkimalla
2020-2021	Charles Nguyen (industry: Apple)
2019-2021	Charlie Wolfe (NSF REU) (industry: Apple)
2021	Caelan MacArthur (NSF DREU)
2020-2021	Taimur Kashif (NSF REU) (industry: VMWare)
2019-2020	Ashton Woiwood (NSF REU)

High School

2019	Kathy Zhong (SSTP)
2018	Alice Martynova (SSTP)
2017	William Kim (SSTP)
2016	Brandon Wang (SSTP)

External Service

Conference TPC/Reviewer	IEEE S&P (2022), PETS (2021, 2020, 2019, 2018, 2017), ACM IMC (2021, 2020), ACM CoNEXT (2019), ACM SIGMETRICS (2023, 2022, 2020, 2013), WWW (2020, 2018), ACM CSCW (2018, 2019), IEEE/IFIP TMA (2020, 2019), NDSS MADWeb Workshop (2019), IEEE INFOCOM (2017, 2015, 2010, 2009), ACM WPES (2018), IEEE S&P Consumer Protection Workshop (2021, 2020), ACM SIGCOMM Internet-QoE Workshop (2017), ACM SIGCOMM Workshop on IoT Security and Privacy (2018), WWW CyberSafety Workshop (2018), WWW Workshop on Location and the Web (2018), IEEE ICNP (2014, 2013), MASCOTS (2013), ICDCN (2017, 2018)
Journal Reviewer	IEEE/ACM Transactions on Networking, ACM Transactions on the Web, IEEE Transactions on Mobile Computing, IEEE Transactions on Network and Service Management, ACM Transactions on Multimedia Computing, IEEE Transactions on Cognitive Communications and Networking, ACM SIGCOMM Computer Communication Review, Elsevier Computer Communications, Elsevier Performance Evaluation, Springer Wireless Networks
PC Co-Chair	Privacy Enhancing Technologies Symposium (PETs), 2024
PC Co-Chair	Workshop on Technology and Consumer Protection (ConPro'23), IEEE Symposium on Security & Privacy ("Oakland")
PC Co-Chair	Workshop on Technology and Consumer Protection (ConPro'22), IEEE Symposium on Security & Privacy ("Oakland")
PC Co-Chair	Workshop on Measurements, Attacks, and Defenses for the Web (MADWeb'23), Network and Distributed System Security Symposium (NDSS)

PC Co-Chair	Workshop on Measurements, Attacks, and Defenses for the Web (MADWeb'22), Network and Distributed System Security Symposium (NDSS)
Publicity Co-Chair	ACM International Conference on emerging Networking EXperiments and Technologies (CoNEXT 2020)
Co-Chair	NSF NeTS Early Career Investigators Workshop 2019
PC Co-Chair	Student Workshop - ACM International Conference on emerging Networking EXperiments and Technologies (CoNEXT 2018)
PC Co-Chair	WWW 8th International Workshop on Location and the Web (LocWeb 2018)
Poster Chair	ACM/IEEE Symposium on Architectures for Networking and Communications Systems (ANCS 2018)
Technical Committee	Elsevier Computer Communications (2015-2019)
Guest Editor	Special Issue on Mobile Traffic Analytics, Elsevier Computer Communications (2016)
Editorial Board	Proceedings on Privacy Enhancing Technologies (PoPETs) (2019, 2020, 2021)
Panelist	NSF (2017, 2018, 2019, 2020, 2021, 2022)

Internal Service

Chair	Departmental Colloquium Series Department of Computer Science, University of California Davis, 2021-2023
Member	Diversity, Equity, Inclusion Committee College of Engineering, University of California Davis, 2021-2022
Committee	Departmental Graduate Committee Department of Computer Science, University of Iowa, 2019-2020
Chair	Departmental Colloquium Series Department of Computer Science, University of Iowa, 2019-2020
Member	Executive Committee, Iowa Initiative for Artificial Intelligence (IIAI) The University of Iowa, 2019-2020
Member	Department Executive Committee Department of Computer Science, The University of Iowa, 2016-2019
Member	Faculty Recruitment Committee Department of Computer Science, The University of Iowa, 2015-2020
Mentor	Black Girls Do Science College of Engineering, The University of Iowa, 2015-2016
Mentor	Iowa Edge Classroom Experience Center for Diversity and Enrichment, The University of Iowa, 2015-2018
Mentor	Summer Research Opportunities Program (SROP) Graduate College, The University of Iowa, 2017
Mentor	Secondary Student Training Program (SSTP) Belin-Blank Center, The University of Iowa, 2016-2019

Patents

USPTO 10484881	Jia Wang, Lusheng Ji, Alex X. Liu, Zubair Shafiq. Optimization of cellular network architecture based on device type-specific traffic dynamics. November 2019
USPTO 10420167	Jia Wang, Lusheng Ji, Alex X. Liu, Jeffrey Pang, Zubair Shafiq. Cellular Connection Sharing. September 2019

Expert Testimony & Reports

4:20-cv-05146	**Calhoun v. Google LLC** U.S. District Court for the Northern District of California; Plaintiffs Expert for Bleichmar Fonti & Auld LLP, Simmons Hanly Conroy LLC, DiCello Levitt Gutzler LLP
4:21-cv-02155	**In re Google RTB Consumer Privacy Litigation** U.S. District Court for the Northern District of California; Plaintiffs Expert for Pritzker Levine LLP, Bleichmar Fonti & Auld LLP, Simmons Hanly Conroy LLC, DiCello Levitt Gutzler LLP, Bottini & Bottini Inc., Cotchett, Pitre & McCarthy, LLP.